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Title: Detonator Production Overview - Supply Chain Collaboration

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Intended for: Presentation to potential supply chain partners

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Detonator Production Overview

Supply Chain Collaboration

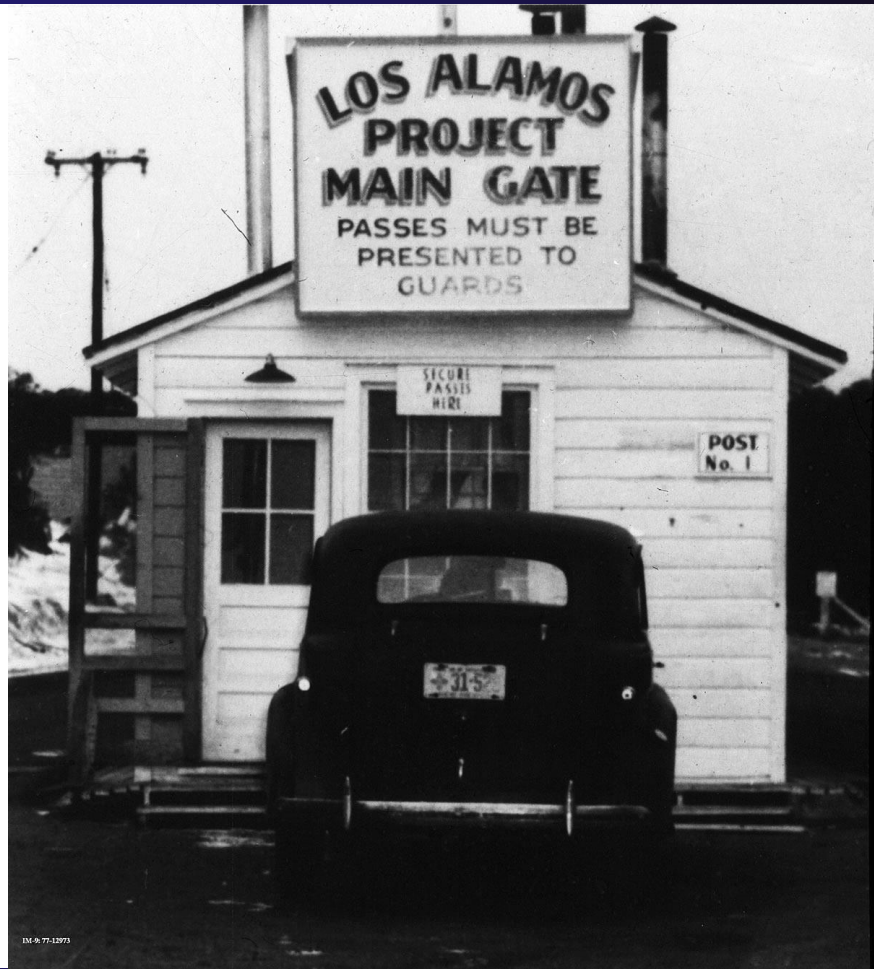
National Nuclear Security Administration
Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

Presentation Outline

- Los Alamos National Laboratory
  - History and WWII legacy
  - Today's Laboratory mission
- Detonator manufacturing in the Nuclear Security Enterprise
  - Evolution of detonator mission at LANL
  - Detonator Production today
- Manufacturing processes
  - Design of a detonator
  - In-house production capabilities
- Expanding our supply chain

Origins of the Lab

- Founded in 1943 to lead the Manhattan Project during WWII
- U.S. government assumed ownership of Los Alamos Ranch School in a remote, mountainous region of northern New Mexico
- Responsible for the development of the first nuclear weapons systems (Little Boy and Fat Man)
- Formally established as a government research facility under the Department of Energy (DOE) after WWII



Delivering the Best Science and Technology

- Mission
  - To solve national security challenges through scientific excellence
- Vision
  - To deliver science and technology to protect our nation and promote world stability
- Values
  - Service
  - Excellence
  - Integrity
  - Teamwork
  - Stewardship
  - Safety and Security

Key Focus Areas

- Nuclear deterrence
- Stockpile stewardship
- Nuclear threat protection
- Cybersecurity threat mitigation
- Energy security solutions
- High performance computing
- Space research
- Health and biosciences
- Earth and environment

Timeline of Detonator Production at LANL

1943 Wartime R&D begins

1949 Production begins at Picatinny Ars.

1950 Production ceases at LANL

1956 Production moves to Mound, OH

1993 Mound plant closes

1995 LANL receives production mission

1999 First stockpile product shipped

2007 First LANL-designed product ships

2018 Mission and R&D increases

Detonator Facility Evolution

“Trap Door” Site (Circa 1950)

R&D environment, minimal infrastructure

Technical Area 22 (Present Day)

10+ production lines, 120+ staff, $42M budget

Essential to the Stockpile

Mission Assignments

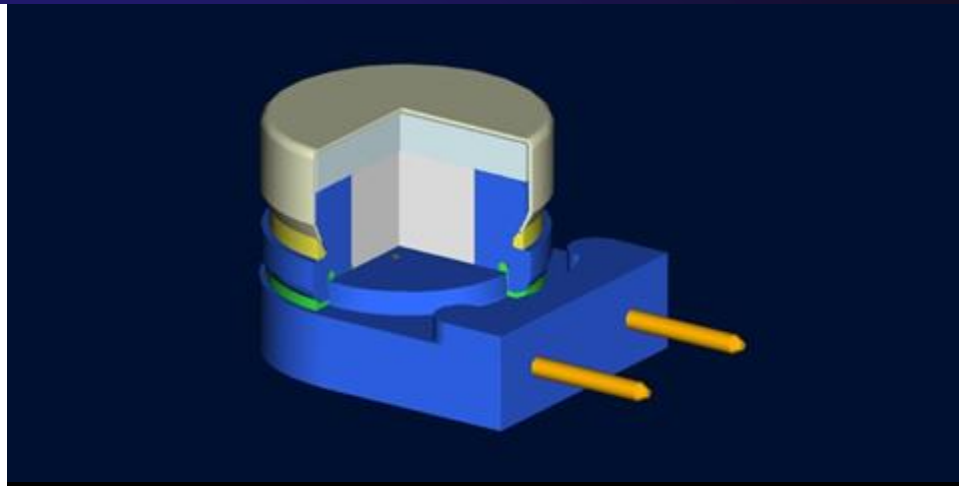
- Production
  - W76, W78, W88 stockpile
  - W88 refresh
  - W80 and B61 LEP
  - W87 stockpile (future)
- Surveillance
  - All LANL systems
- Research & Development
  - New designs
  - Advanced concepts
  - Hydrotesting
  - Stockpile concerns
  - Global security

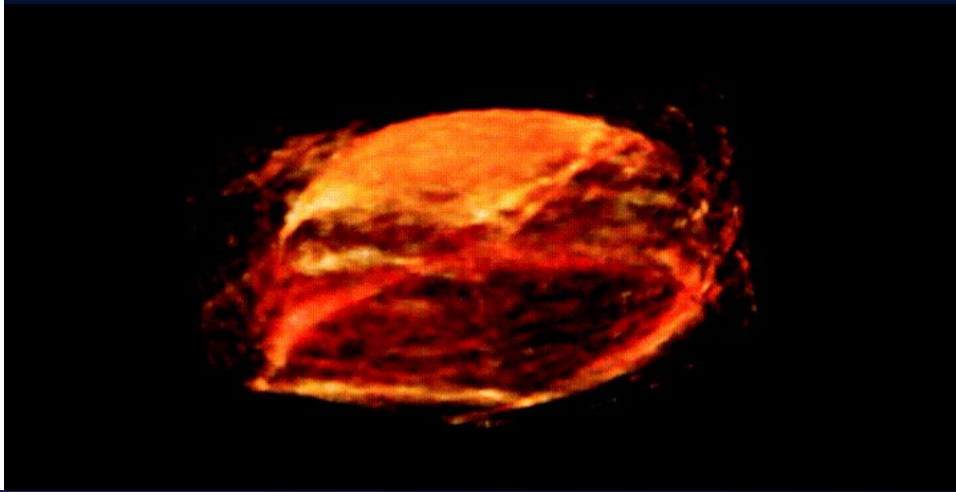
Mission Deliverables

- Production
  - 1E33, 1E38, 1E40, 4E10
  - MC5108 detonator
  - Actuators
  - Cables
- Surveillance
  - Annual assessment reports
- Research & Development
  - Hydrotest cables
  - LEP development
  - Test hardware
  - Special projects

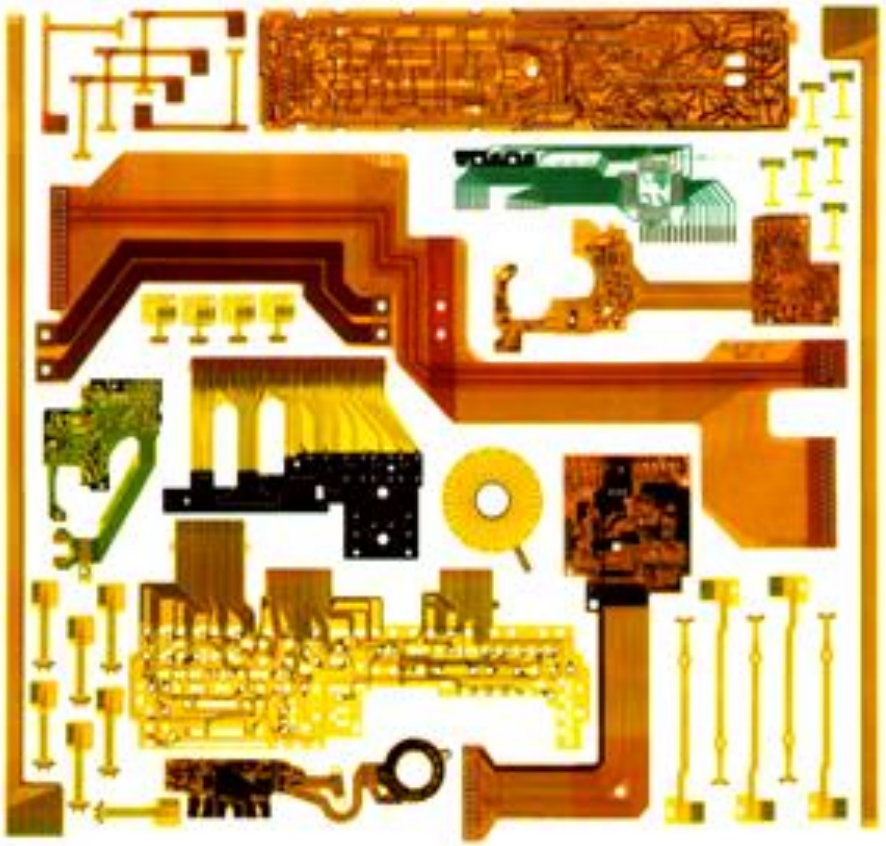
Detonator Components

- Bill of materials
  - Cup
  - High explosive (HE) powder
  - Header preload
  - Cable
- Typical production processes
  - High density pressing
  - Low density pressing
  - Cable manufacturing
  - Assembly
  - Non-destructive testing
  - Test fire (as required)





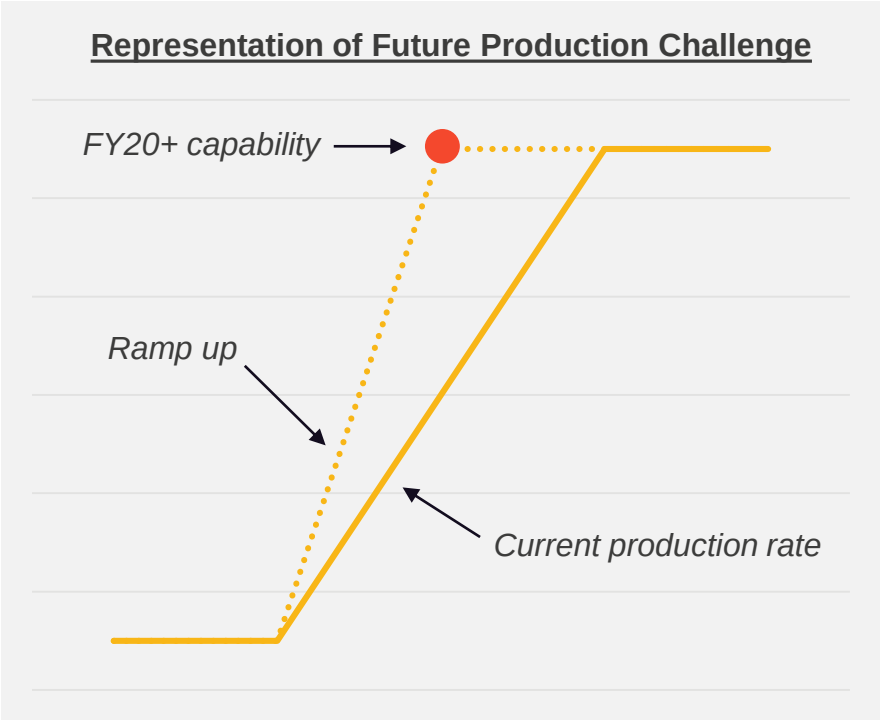
Production Capabilities



- High explosive (HE) components
- Inert components
- Processes
  - HE pressing
  - Laser welding
  - Photolithography
  - Polymer potting and molding
  - Glass ceramic sealing
  - Cable manufacturing
  - Manual component assembly
  - Electrical testing

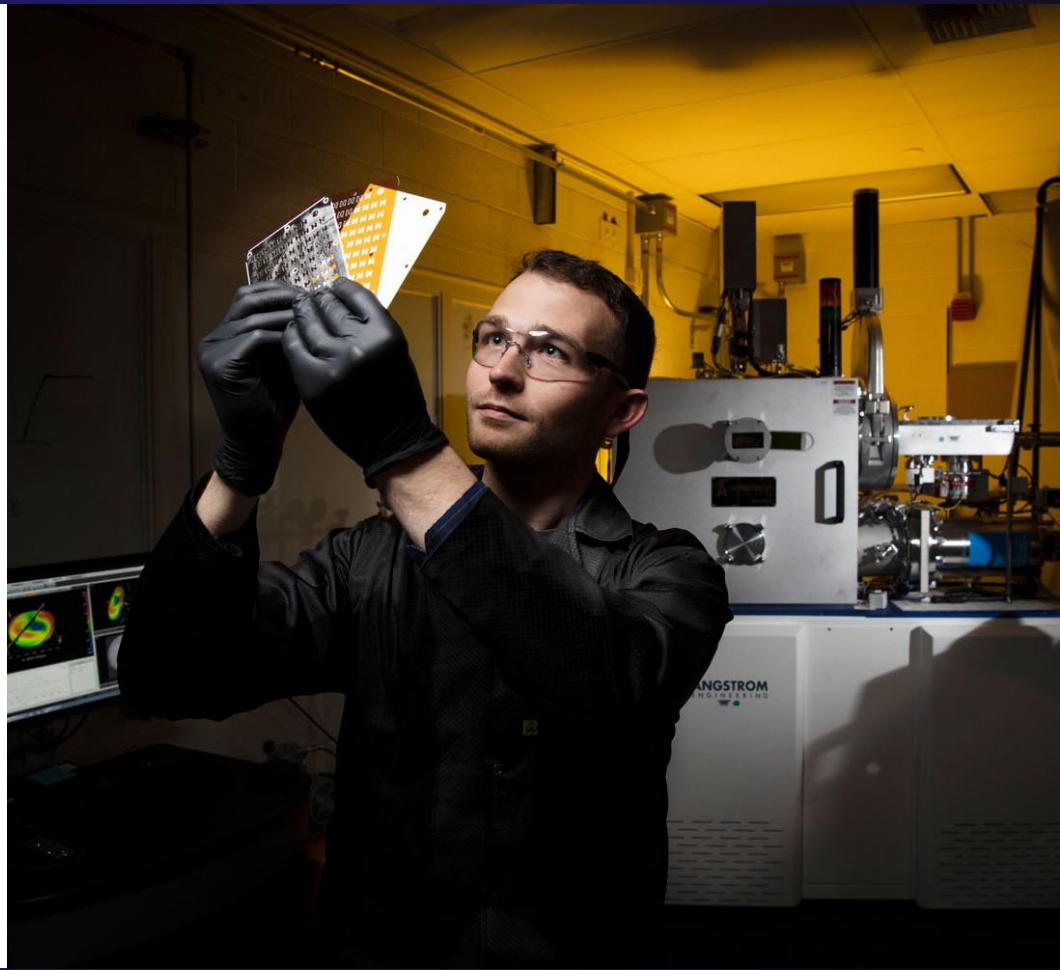
Increasing Production Scope

- Challenges to our division
  - Process development
  - Staffing
  - Production space
  - Facility upgrades
- Challenges to our suppliers
  - Vendor qualification burden
  - Low production quantities
  - Document handling and storage
  - Rigor of quality requirements
- ***We need your help!***



Supply Chain Partnership

- Product line components
  - Cables
  - Connectors
  - Cups
  - Electronic assemblies
- Future design concepts
  - Miniaturized capacitors
  - Switches
  - Voltage converters
  - Optical charging
  - Microelectronics

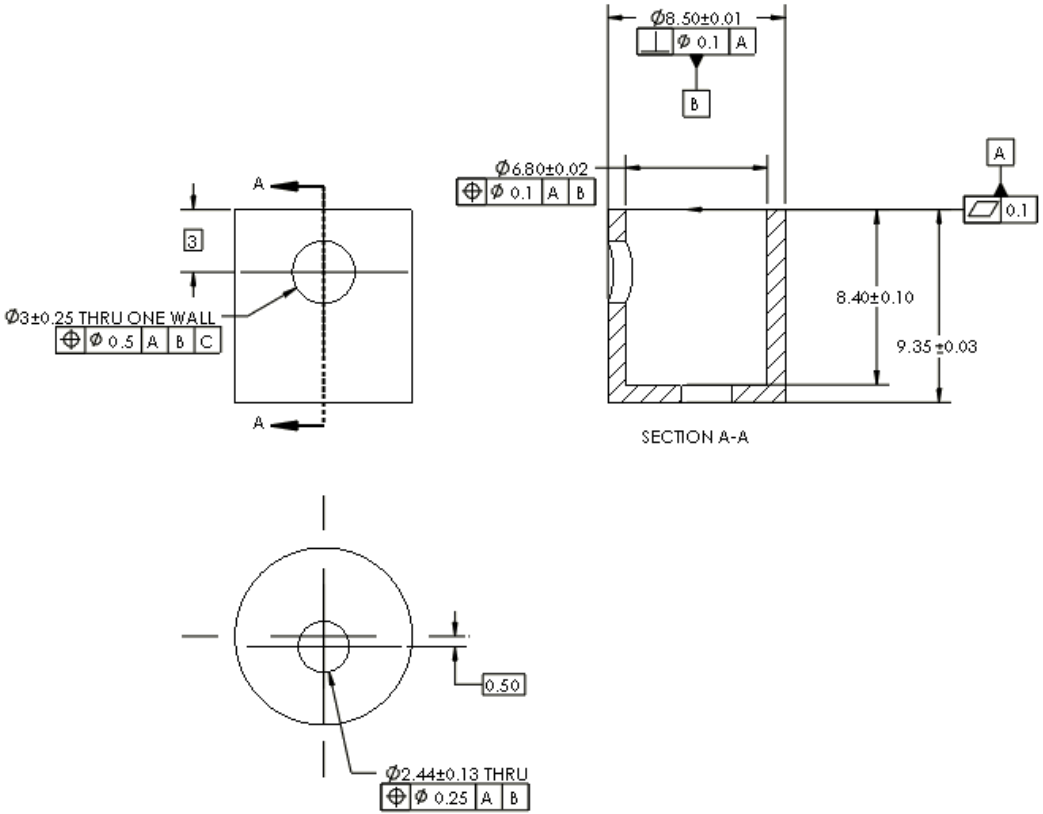


Manufacturing Needs

- Machining
  - 5-axis machining with non-chlorinated coolant
  - Centerless grinding (±.00025” diametrical tolerance)
  - High-speed (50k+ rpm) multi-material plunge grinding
  - Ultrasonic machining
- Electronic
  - Potting and encapsulation
  - SMT assembly
  - Radiation-hardened components
- Value-added services
  - CMM and advanced inspection methods
  - Electroplating

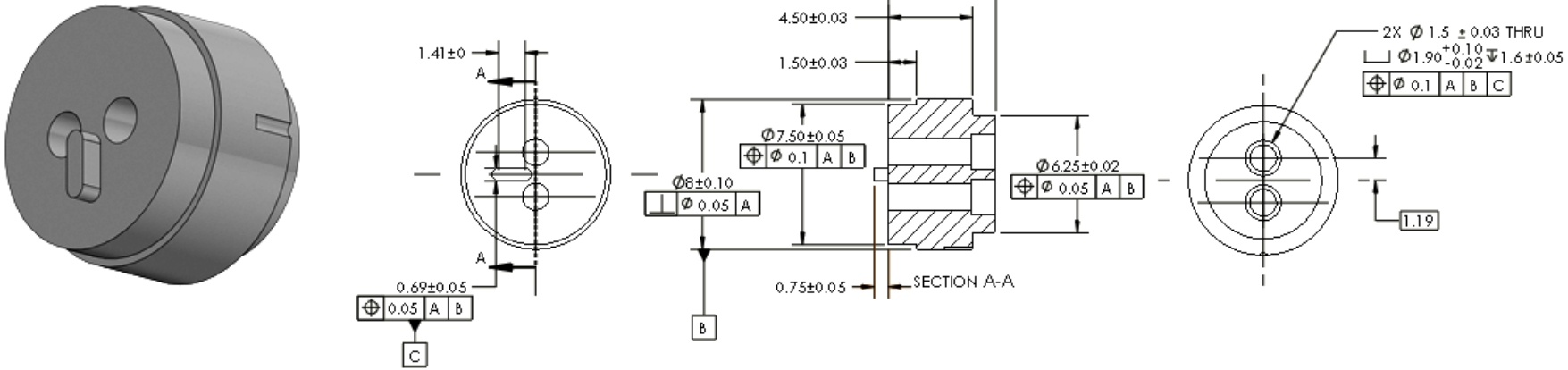
Sample Parts

Sleeve (PEEK)



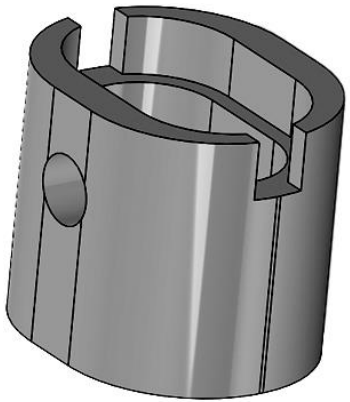
Process: CNC machining

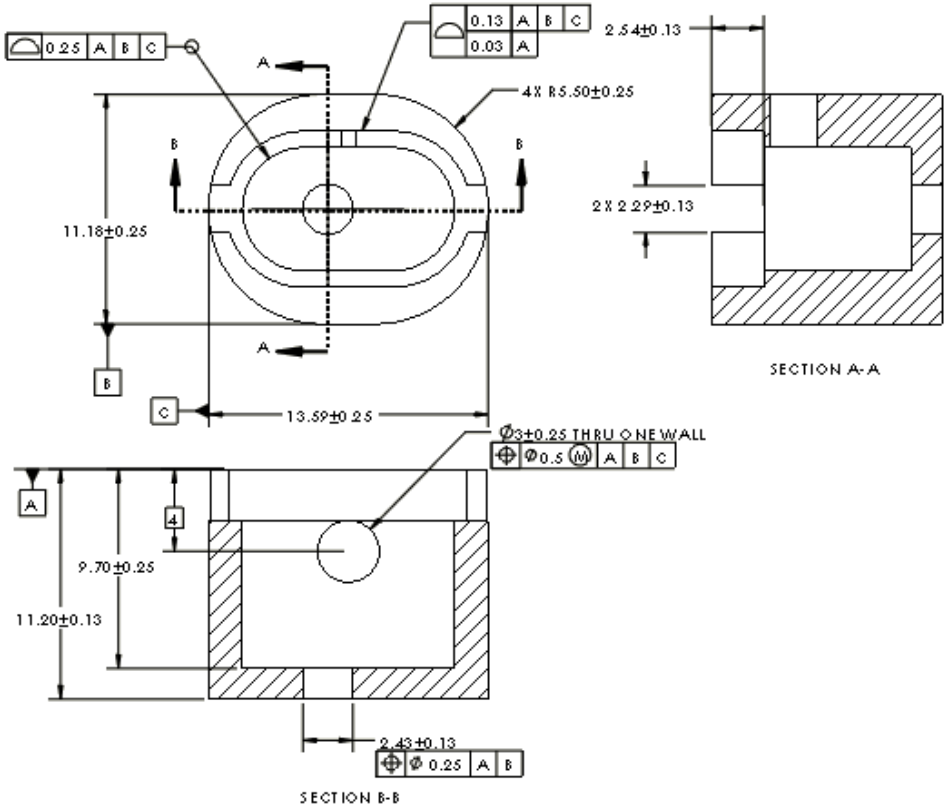
Connector (PEEK)



Process: CNC machining

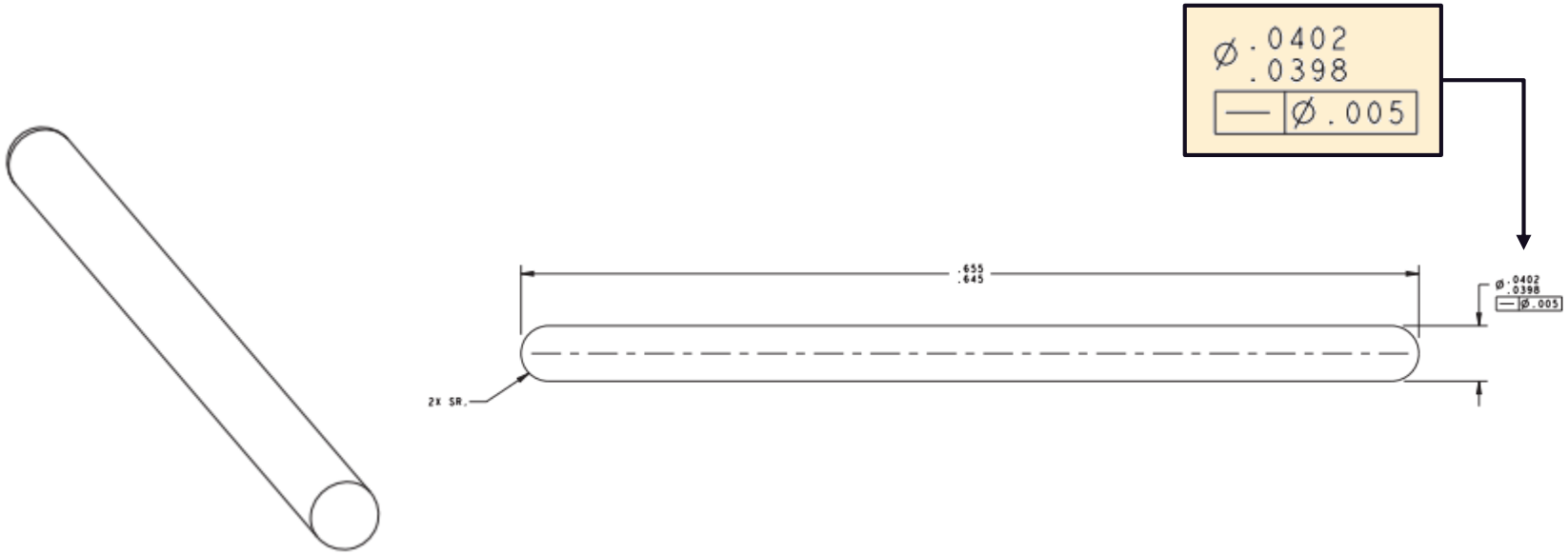
Clip (PEEK)





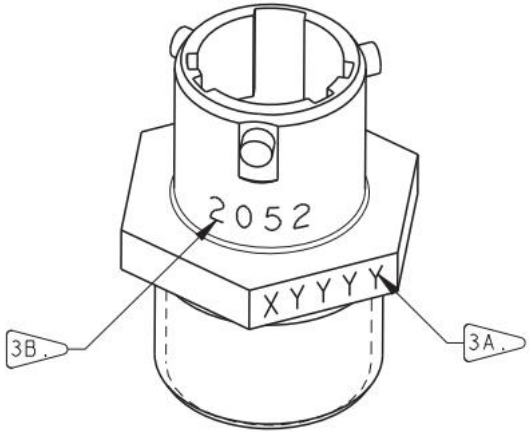
Process: CNC machining

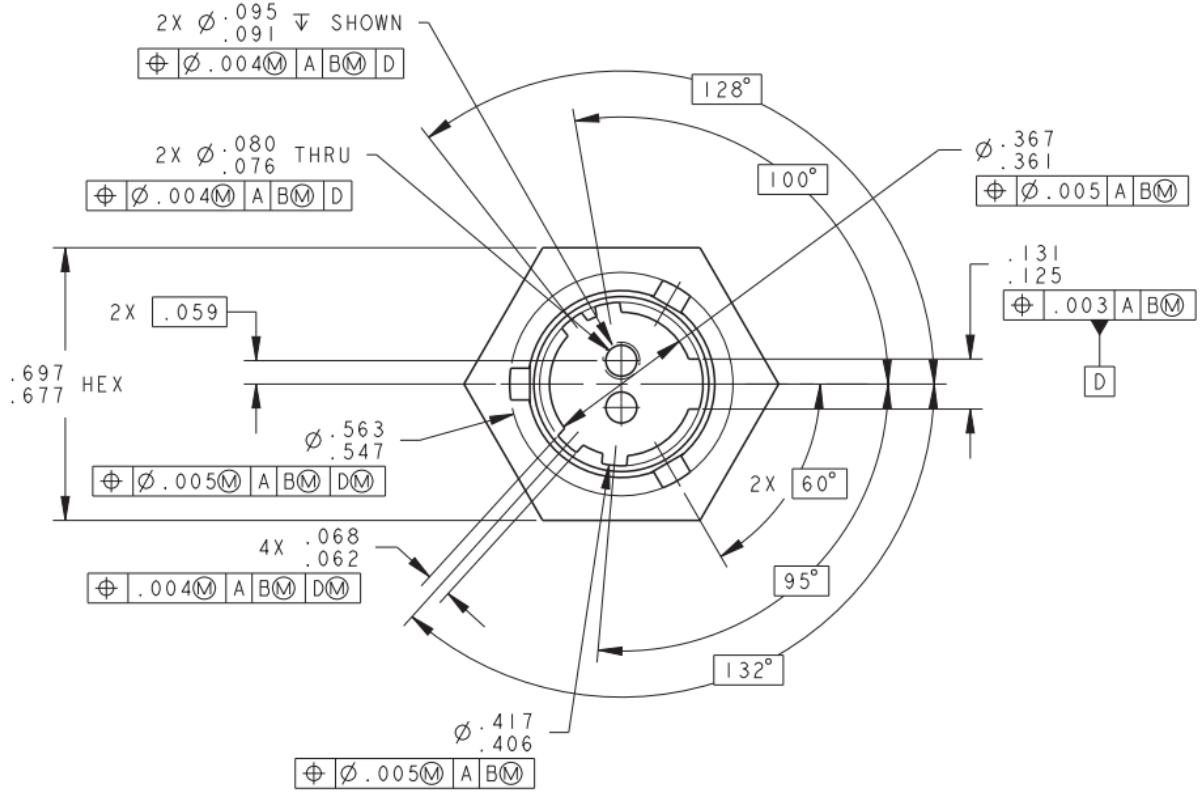
Pin (Hastelloy C-276)



Process: centerless grinding

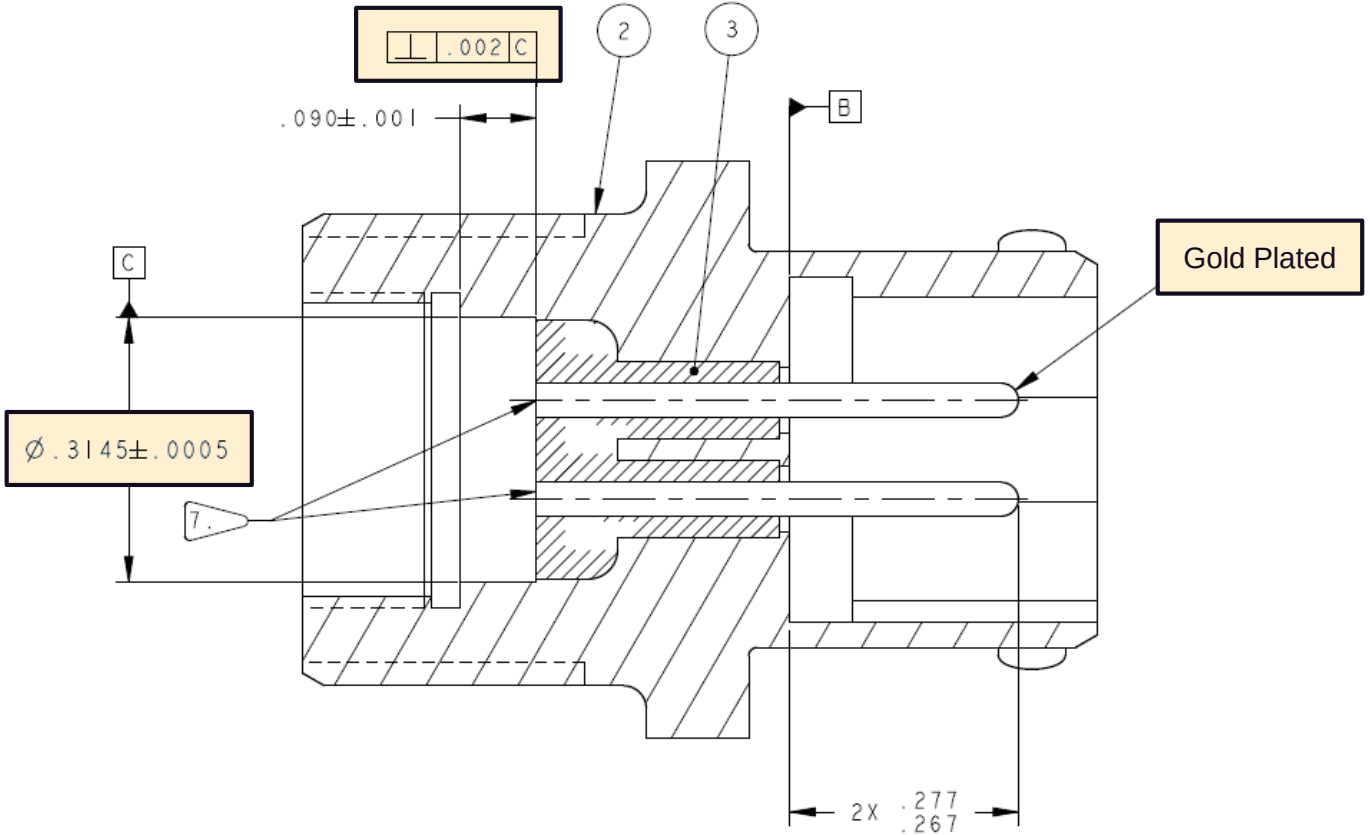
Header Shell (Inconel 718)





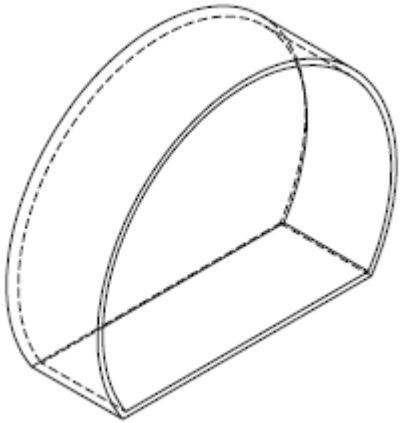
Processes: 5-axis machining, plunge EDM

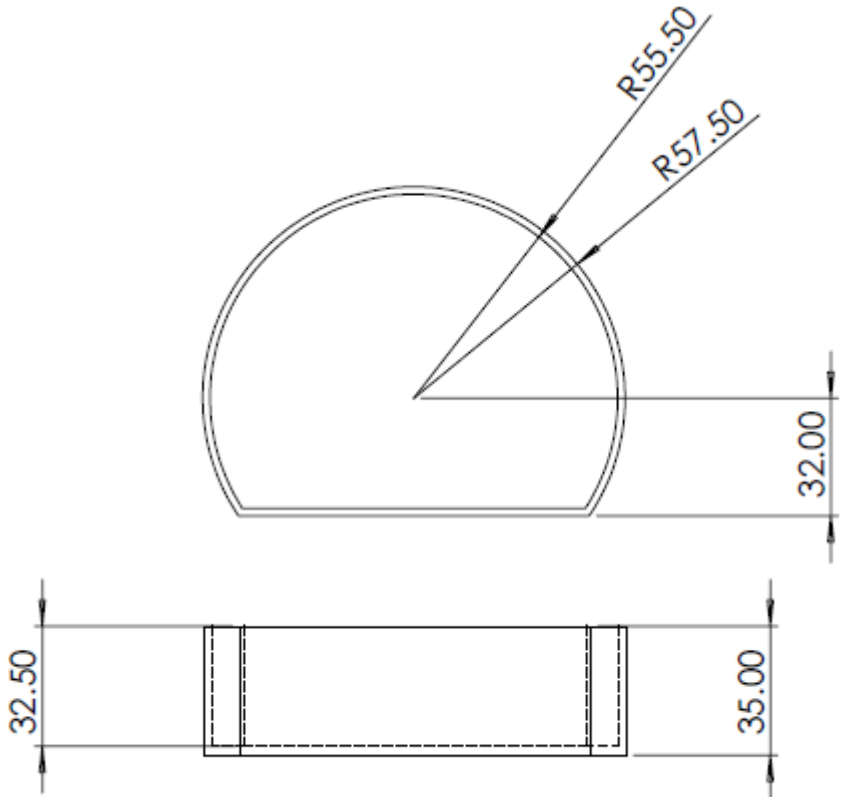
Header Assembly (Inconel, Ceramic, Hastelloy)



Process: high-speed plunge grinding or ultrasonic machining

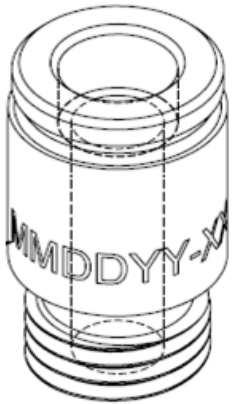
Housing (Aluminum or Titanium)

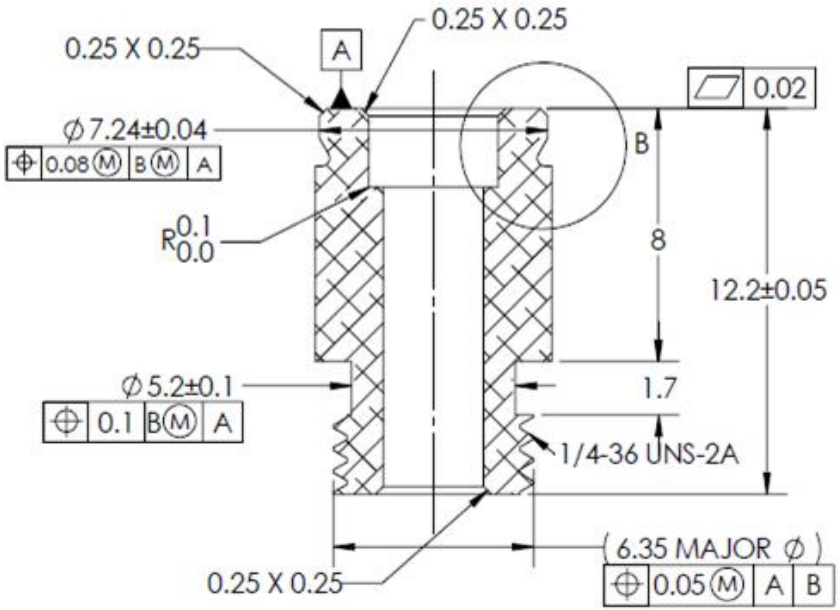


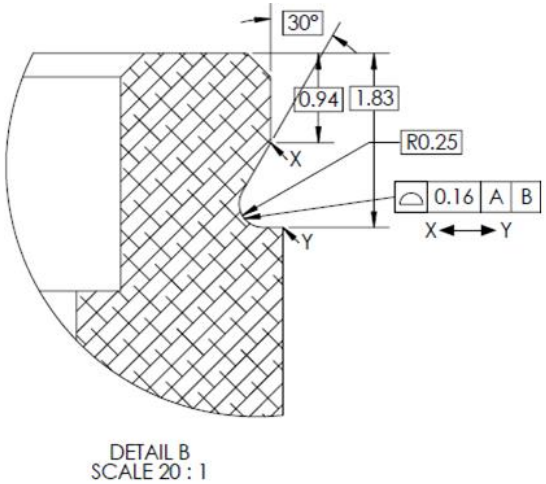


Tolerances: <0.1 mm

Header (Aluminum)







Process: CNC machining

Firing Set (PCB Assembly)

Category	Quantity	Description
PCB	2	2 Layer through hole PCB ~2" x 2"
	2	2 Layer SMT PCB ~2" x 1"
	1	2 Layer SMT PCB ~4" x 1.5"
Components	8	e-Cap tantalum ~2000µF
	1	Ceramic Cap ~1µF
	13	Small SMT Resistors ~3mm x 2mm
	3	Large SMT Resistsors 600K
	1	Transformer large Block/Square style
	1	Transformer IC Ring Style
	1	20 Pin Input/Output connector
	1	2 Pin Input/Output
	1	4 Pin Input/Output
	1	PCP to PCB connector (90 deg join style)
	3	Power MOSFET
	1	IC Op Amp
	2	Diode high power rated
	1	Opto-Isolator
	1	MOSFET Driver

Special requirements: radiation-hardened components